SURVEY OF CITRUS BMPS IN THE GULF CITRUS PRODUCTION REGION

Sanjay Shukla*

Robert E. Rouse*

Shuchi S. Shukla*

Kenneth M. Portier**

Thomas. A. Obreza***

Edward. A. Hanlon*

* Southwest Florida Research and Education Center, UF-IFAS, Immokalee

** Statistics Department, UF-IFAS, Gainesville

*** Soil and Water Science Department, UF-IFAS, Gainesville

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Contact Person: Sanjay Shukla
Agricultural and Biological Engineering Department
Southwest Florida Research and Education Center, UF-IFAS,
2686 SR 29 N, Immokalee, FL 34142. Tel 239-658-3400

Executive Summary

A survey of citrus BMPs was conducted in the Gulf Citrus Production Region, covering 60 groves and an area of 115,791 acres. The surveyed groves comprised 65% of the total acreage in the region. The BMPs were split into five categories, water, sediment, pesticide, nutrients, and aquatic plants. Survey-responses indicating no use, consistent use, and would be used if cost-shared were considered to be of greatest importance for the purpose of this study.

Responses for water management-related BMPs indicated that for more than 50% of the surveyed acreage, all practices included in the survey have been implemented. When asked about a variety of sediment, pesticide, and nutrient BMPs, it was inferred that more than 50% of the BMPs were implemented on an area that exceeded 50% of the total surveyed acreage.

The survey emphasized the insufficient presence of a BMP or its prevalence. Survey results also highlighted acreage where cost-share programs are needed to facilitate BMP implementation.

BMPs that were used consistently on the 100% of the total surveyed acreage were:

- Use and maintenance of vegetative cover near canal or ditch banks to stabilize soils
- Calibration of fertilizer spreaders before each application
- Avoiding fertilizer applications under high water table and flooded conditions

BMPs that were implemented on less than 50% of the total surveyed acreage were:

- Placement of tarp underneath fertilizer spreaders while loading the fertilizer and reuse of spilled fertilizer
- Use of water from retention/detention reservoirs for irrigation
- Accounting of the nutrients from organic amendments and adjusting the fertilizer rates accordingly

BMPs that needed cost-share assistance on more than 30% of the total surveyed acreage:

- Reuse of pesticide equipment wash-water
- Placement of tarp underneath fertilizer spreader while loading the fertilizer and reuse of spilled fertilizer
- Construction and use of concrete floor with a 4-inch lip for the pesticide storage facility

Results from this survey provided a baseline data for BMP implementation. The survey could be used to develop a research and educational program for those BMPs that are not currently implemented, possibly due to lack of understanding or awareness of the value of underutilized BMPs or high cost. Results of this survey must be considered in light of BMPs' effectiveness to protect the environment and producers' cost to implement.

Background

In the mid 1980s, much of central Florida's citrus industry was destroyed due to severe cold and freeze conditions. Since then there has been a shift in citrus production areas towards the southern part of the state. The commercial production of citrus from the Gulf Citrus Production Region (GCPR) has intensified in recent years due to warmer climatic, sufficient water, and less expensive land. Citrus groves in the five-county Gulf region (Charlotte, Collier, Glades, Hendry and Lee), extends to 178,000 acres, which represents approximately 25% of the total citrus acreage as well as citrus production in the state.

In the past 3 years, the industry has faced both water quantity and quality issues. A Total Maximum Daily Load (TMDL) program is in development for all major waterbodies in the region including the Caloosahatchee River, and scheduled to be completed in 2007. While a citrus BMP Manual has been developed for other regions in Florida such as the Indian River and Peace River watersheds, the manual for the Caloosahatchee River basin and other areas of the Gulf production region has not yet been finalized. For successful implementation of BMPs in the GCPR, background information on the current level of implementation is necessary.

To avoid the regulatory approach, the Florida Department of Agriculture and Consumer Services, is working with UF-IFAS and local growers to develop water and nutrient BMPs for citrus production. Growers in the GCPR have already adopted many modern practices in their citrus production practices, including the use of riser boards and stormwater impoundments. However, the percent of acreage operated with these BMPs is not known. The Gulf Citrus Production Survey was done to identify BMPs that are already in use and to identify BMPs that need to be adopted.

Methodology

In 2002, the Southwest Florida UF-IFAS Citrus Advisory Committee initiated a process to identify current citrus production (water, nutrient, sediment, pesticide, and aquatic weeds) management practices in southwest Florida citrus groves. The Gulf Citrus Growers Association

(GCGA) board members approved the development of a grower survey to document current production practices. Later in the year, a sub-committee appointed by the UF-IFAS Citrus Advisory Committee drafted a copy of survey questions. The survey included water and agrichemical management practices ranging from soil moisture measurement technology for irrigation scheduling to soil and leaf analysis for informed nutrient management decisions. To maximize the survey success rate and get better information, survey responses were completed through personal contacts and interviews rather than through mail. The survey achieved a great deal of involvement from the members of the citrus industry in southwest Florida.

BMP Survey Categories

The survey questionnaire was designed to include five major areas of crucial water-quality BMPs: water, sediment, pesticides, nutrients, and aquatic plants control. In addition to the specific questions regarding these categories, some general questions related to the importance of BMPs with regards to water quality benefits and grove profits were also included. Each of the categories had several questions. To know if a particular practice was in use the growers were asked if they implemented it consistently or not. The remaining choice of 'sometimes' determined the frequency of utilization of a particular practice. To understand if a BMP was not popularly accepted growers were asked if they disagreed with that practice. To determine whether a grower could implement a practice in future, two additional choices, 'plan to use' and 'would if cost shared' were also added. The latter choice determined the potential of a specific BMP to be implemented if there were federal and/or state cost share funding available to pay for part of the implementation cost.

Data Analysis

Sixty groves covering an area of 115,791 acres were surveyed (Table 1). The surveyed acreage was distributed between large (1000 acres and larger), medium (250 to 1000 acres), and small groves (250 acres to smaller). From water quality standpoint, percent of acreage using a specific practice is often more important than percent of the groves. Therefore, almost all of the large groves in the region (104,170 acres) were included in the survey. Seventy-five percent of medium-size groves in GCPR were surveyed, which accounted for 9,982 acres. Small groves only accounted 1,639 acres of the total acreage. The grove name and location were kept confidential. For the convenience in data analysis, the survey questions were coded for different categories indexed with the initial of that survey category name. For example, the water survey questions were coded as W1, W2…, sediment questions were indexed as S1, S2…and so forth. The sample survey-form (**Appendix 1**) indicates the question codes and associated questions.

Table 1 Distribution of Surveyed area by grove size.

Grove Size	Acreage	Number of groves	% of total surveyed acres
Large	104,170	31	89.96
Medium	9,982	18	8.62
Small	1,639	11	1.415

The survey data were analyzed to calculate the total acreage for a specific practice by response. The data were analyzed using Statistical Analysis Software (SAS). Data analyses for this project addressed aggregated response of the growers in the GCPR.

Results and Discussion

Growers representing 62% of the area (71,757 acres) indicated that a citrus BMP was important only if that practice returned a net profit on the investment. For an area of 32,809 acres (28%), growers rated the necessity of a BMP to return a net profit as moderately important, whereas, on 11,225 acres the criterion was only of slight importance. On the other hand, growers from more than 74% of the area reported the importance of BMPs to reduce pollution to be an important factor. Growers from only 25% of the area said that BMP implementation from pollution standpoint was of moderate importance.

The survey also determined that micro-sprinkler irrigation was the most common water system used, as it was prevalent on at least 62% of the area (72,288 acres). Seepage and drip irrigation systems were used on 8333 and 7,991 acres respectively. However, on 27,197 acres irrigation was achieved through a combined use of micro-sprinkler and drip. Overall, on 93% (107,458 acres) of the surveyed area micro-irrigation use was common, where only 7.2% of that area was irrigated by seepage techniques alone. Such higher percent acreage under microirrigation system is clear indication that citrus water use in GCPR is highly efficient. Furthermore, use of microirrigation also has the potential to reduce the water quality impacts due to ability to apply fertilizer through fertigation.

Results of the survey for three response choices are summarized in Table 2 (Appendix 2.). Discussion on survey results is divided by the five practice categories: water, sediment, pesticides, nutrients, and aquatic plants.

Water

Figure 1 is a graphical representation of the total acreage for the three survey choices: *no, yes,* and *would if cost-shared*. Figure 2 represents the proportion of acreage for those choices. More than 60% of the BMPs were implemented on more than 60% of the area, which was approximately 69,474 acres. Efficient irrigation requires a methodical water management program. Such a program addresses the issues of irrigation timing, how much water to apply, and at what rate. Survey question W1, 'Do you use a rain gauge for irrigation management?' was a practice that was implemented on 99% of the surveyed acreage (114,641 acres).

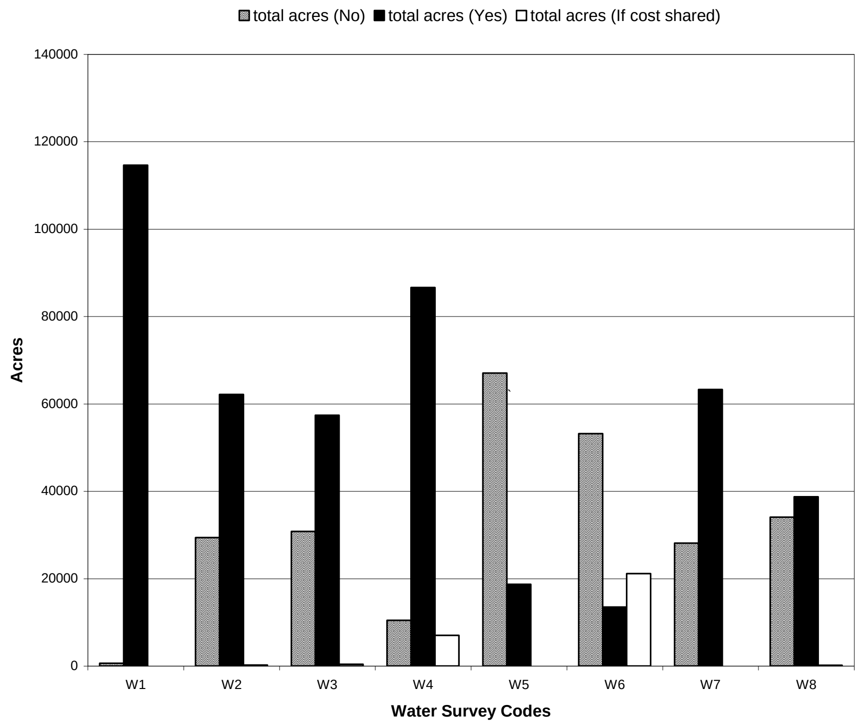

Figure 1. Acreage for water management practices with responses- No, Yes, and If Cost Shared.

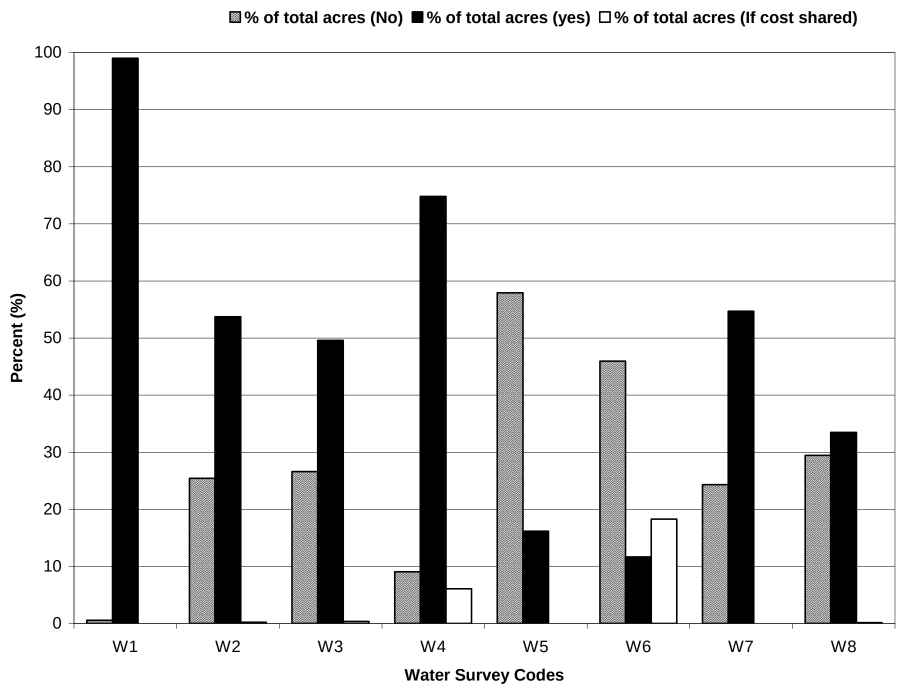

Figure 2. Percentage of total acreage for water management practices with responses- No, Yes, and If Cost Shared.

On 29,409 acres water-budget technique (W2) was not utilized to schedule irrigation. This practice was utilized consistently only on 54% of the surveyed grove area. The cost-share option was chosen for around 240 acres.

An important element of sound irrigation water management is the regular monitoring and measurement of soil water. Soil water must be maintained between known high and low limits of availability to citrus trees, which requires accounting for soil evaporation, crop water use, irrigation, drainage and rainfall. Accurate assessment of soil water-holding characteristics along with periodic soil water monitoring and measurement are required to avoid both under-irrigation and over-irrigation, the leaching of nutrients or chemicals below the root-zone and degradation of surface water supplies by sediment-loaded runoff water. Soil moisture measurement and/or water table depth-based irrigation scheduling (W3) are important practices. These practices not only conserve water and nutrients and reduce water quality impacts but also reduce production cost by reducing fuel and fertilizer inputs. On approximately 50% of the total surveyed area (57,400 acres) this management practice was prevalent.

Detention/retention reservoirs serve to control storm water volume and reduce water quality impacts by retaining dissolved and sediment bound agrichemicals. Use of retention/detention areas (W4) was present on 86,608 acres (>74%). Only 9% of the surveyed groves did not have on-site retention/detention areas. Cost-share could increase the implementation of this practice on and additional 7% (7,033 acres) of the surveyed area.

Discharge water from detention/retention areas (reservoirs) is regulated by the South Florida Water Management District (SFWMD) and requires a permit for using reservoir water for irrigation. On the question whether permit allowed use of reservoir water as a source of irrigation water supply (W5), growers representing 18,724 acres (16%) responded yes. However, this water source was used for irrigation on only 13,493 acres of those acres (11% of the total area). Growers representing 21,158 acres (18% of the total surveyed acres) said they would like to use the reservoir water for irrigation (W6) if it was cost shared. Use of canals and ditches to hold runoff/drainage water in the groves (W7) was practiced on 63,316 acres (55%). Retaining water in the ditches and use of reservoir water for irrigation can potentially result in on-site retention of nutrients. On at least 29% of the total surveyed area, no line cleaning chemicals, to prevent microirrigation emitter clogging was used (W8). Overall, at least 44% of the growers representing 50% of the total acreage said that they use all of the eight water management practices.

Sediment

Survey results shown in Figure 3 indicate that for most of the sediment related questions, majority of the growers answered ‘yes’. Figure 4 shows the same responses as percentage acreage under a sediment management practice.

Settling basins or sumps control erosion and sediment/nutrient loss by slowing the surface-water velocity and allowing solids to settle by retaining runoff within the grove drainage system. Thus, settling basins/sumps are considered important for the purposes of soil and water conservation. On 51,154 acres (44% of the total surveyed groves) settling bass/sumps were used consistently (S1). On 34% of the remaining 56% of the acreage, establishment of settling basins/sumps could be achieved by cost-share. On 28,213 acres (24% of total) settling basins were inspected and maintained regularly for proper functioning (S3). For only 14% of the area (16,042 acres) inspection/maintenance was not a regular exercise.

Most of the sediment BMPs (S2, S4, S6, S7, S9, and S11), were adopted across more than 90% of the surveyed acreage. This level of adoption within GCPR is very encouraging with regards to reducing sediment and sediment bound nutrient and pesticide losses.

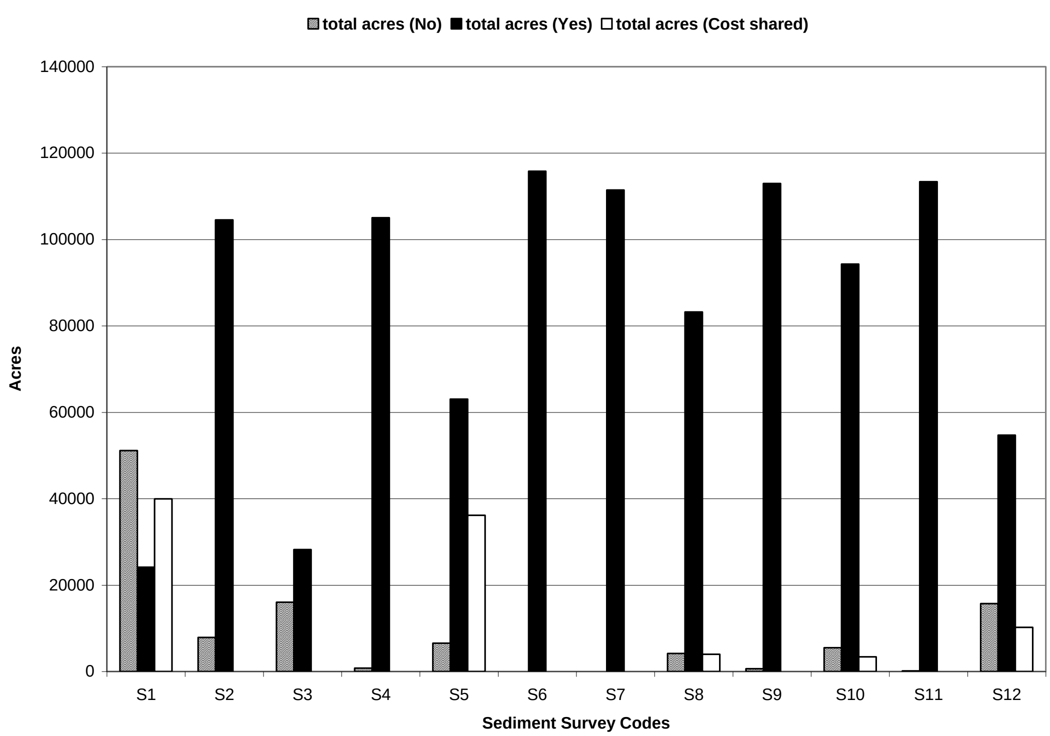

Figure 3. Acreage for sediment control practices with responses- No, Yes, and If Cost Shared

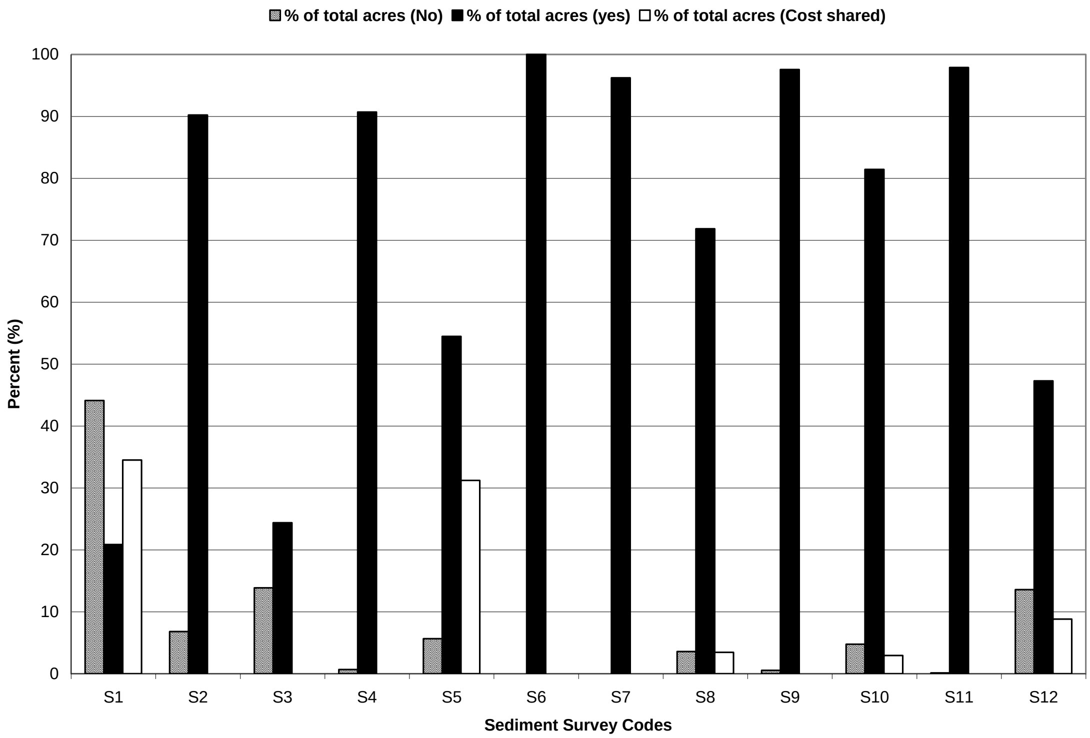

Figure 4. Percentage of total acreage for sediment control practices with responses- No, Yes, and If Cost Shared.

The entire surveyed area (100%) had a vegetative cover maintained near canals or ditch banks to stabilize soils (S6). On 104,552 acres (>90% of total) herbicide band width was restricted to beneath the tree canopy dripline (S2). On 105021 acres (> 90% of total), sediments from the ditch and canal cleaning operations (S4) were placed away from the bank to minimize its reentry into the drainage system. On 96% of the acreage (112,971 acres) following practices were used consistently: sloped bank shoulders to minimize overland flow of stormwater directly down banks (S7); vegetative water furrows, drain tiles, and settling basins used to ensure minimum movement of sediment (S9); and inspection and maintenance of culvert structures (S11).

Riser-board structures create a low current zone near the bottom of the structure that facilitates sediment deposition, essentially reducing its mass in the discharged water. Sedimentation occurs because water is forced to flow over the top of the boards. Conversely, screw-gate structures do not create this dead-current zone. Since they open from the bottom, considerable sediment (and sediment bound agrichemicals) mass is transported along with the discharge water. Majority of the acreage (63,063 acres; > 50%) utilized riser boards rather than screw gates to minimize sediment release (S5). On an additional 31% (36158 acres) riser boards could be established if the cost was shared.

Pesticide

Similar to the sediment results the pesticide category also revealed many positive aspects to growers' use of pesticide (Figures 5. and Figure 6).

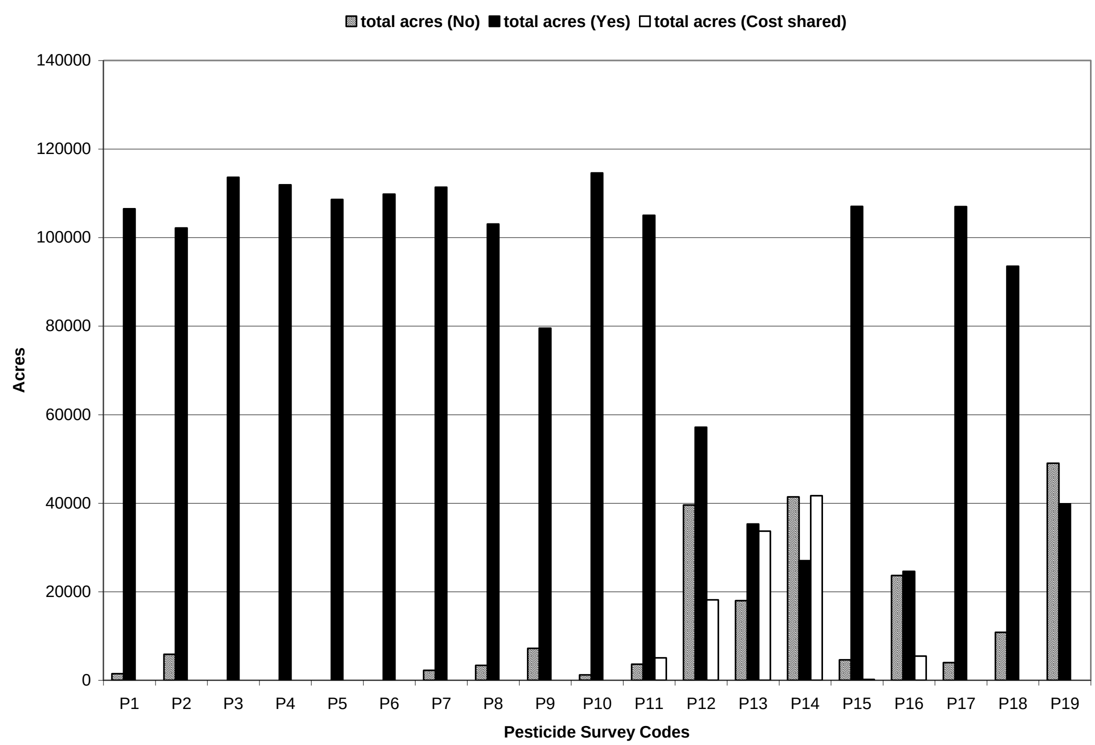

Figure 5. Acreage for pesticide management practices with responses- No, Yes, and If Cost Shared.

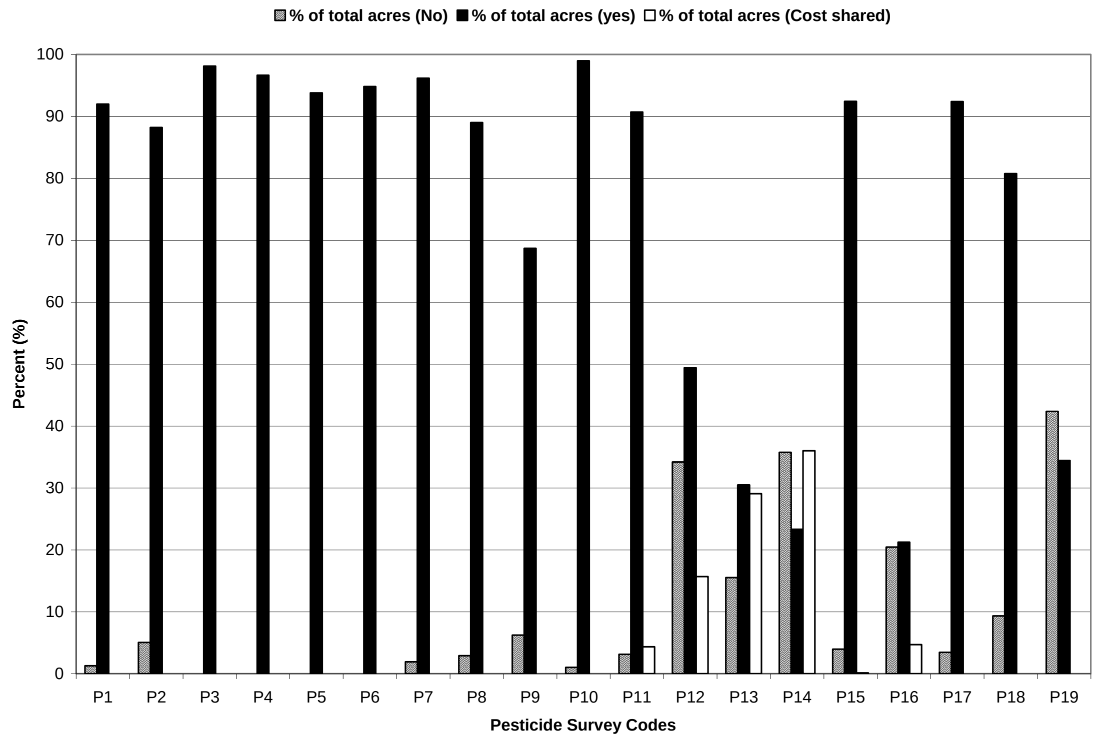

Figure 6. Percentage of total acreage for pesticide management practices with responses- No, Yes, and If Cost Shared.

Growers representing more than 90% of the surveyed area answered 'yes' for 52% of the 19 practices. About 12 out of 19 practices were adopted on 80% or more of the surveyed acres (Figure 6).

Pesticides were stored in a locked storage facility with concrete floor and 4-inch lip (P12) that served 49% (57,182 acres) of the grove areas while 34% of the area did not have this structure. Cost-share program could increase the possibility of construction of concrete floor with 4-inch spill-prevention lip on pesticide storage facilities for 18,164 acres (16%) of the surveyed groves. The 4-inch lip was one of the structural practices for which the growers/managers representing 8% of the total acreage disagreed. Growers representing a similar percentage (9%) of the acreage disagreed with P16 (If pesticides are mixed at or near the same site year after year, is there a concrete pad with sump to minimize contamination from small spills and leaks?). Growers from 20% of surveyed area (24,605 acres) followed this practice, whereas, growers from an equal area did not implement this practice. Question P14 asked if pesticide equipment wash-water was collected for reuse. Growers representing 36% (41,683 acres) of the surveyed area said that they would implement this practice if it was cost-shared. The recycling of wash-water was practiced on 23% of the total area. The remaining 36% of total acreage was managed without this practice. Collection and reuse of equipment wash-water (P13) was closely linked to P14. Increasing the use of this practice through cost-share could improve the practice of collecting and reusing of pesticide equipment wash-water.

Portable mix/load stations or water-only nurse tanks (P18) was a popular practice used on 80% (93,527 acres) of the surveyed area. Mix locations were used more than once in the same year (P19) on only 34% of the total area.

Nutrients

Nutrient survey results (Figures 7 and 8) indicate wide-scale implementation of most of the practices in this category. Practices N2, N12, N18, N, 24, and N26, were implemented on less than 50% of the total acreage. Out of 27 survey questions 74% of the practices were prevalent on more than 50% of the total acres and 44% of the practices were practiced on more than 90% of the total acreage. Such large acceptance and use of nutrient-related practices can be considered as a positive step by the citrus industry with regards to environmental protection.

Growers representing 95% of the surveyed area were aware of UF-IFAS fertilizer recommendations (SP-169), however, these recommendations were followed on 47% of the total area. On 72,761-acres (62% of the total area) training of fertilizer application personnel was documented (N6), whereas on 20% of the area this was not done. It was also observed that growers representing at least 9% of the surveyed area did not agree with UF-IFAS recommendations for fertilizer application.

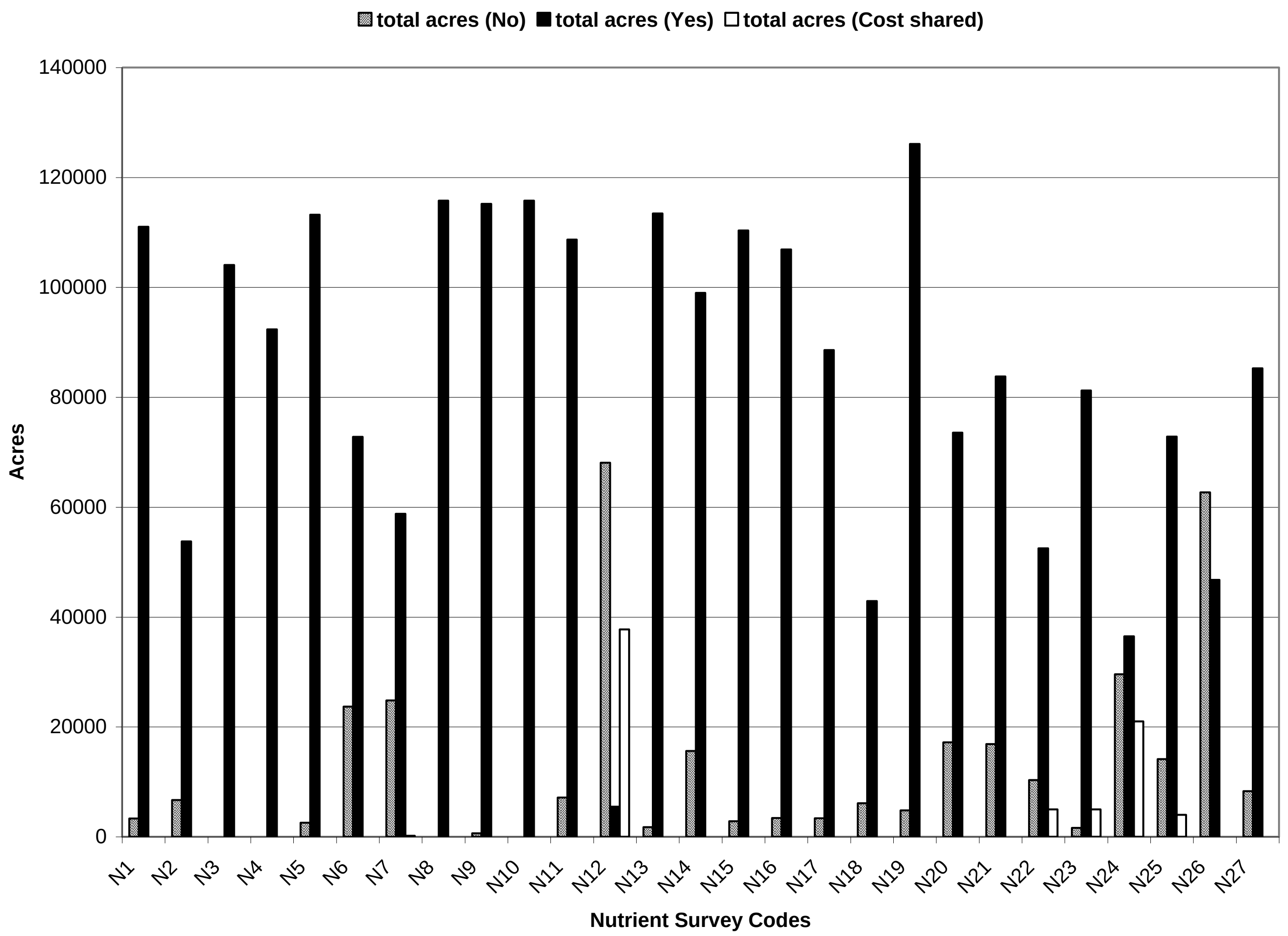

Figure 7. Acreage for nutrient management practices with responses- No, Yes, and If Cost Shared.

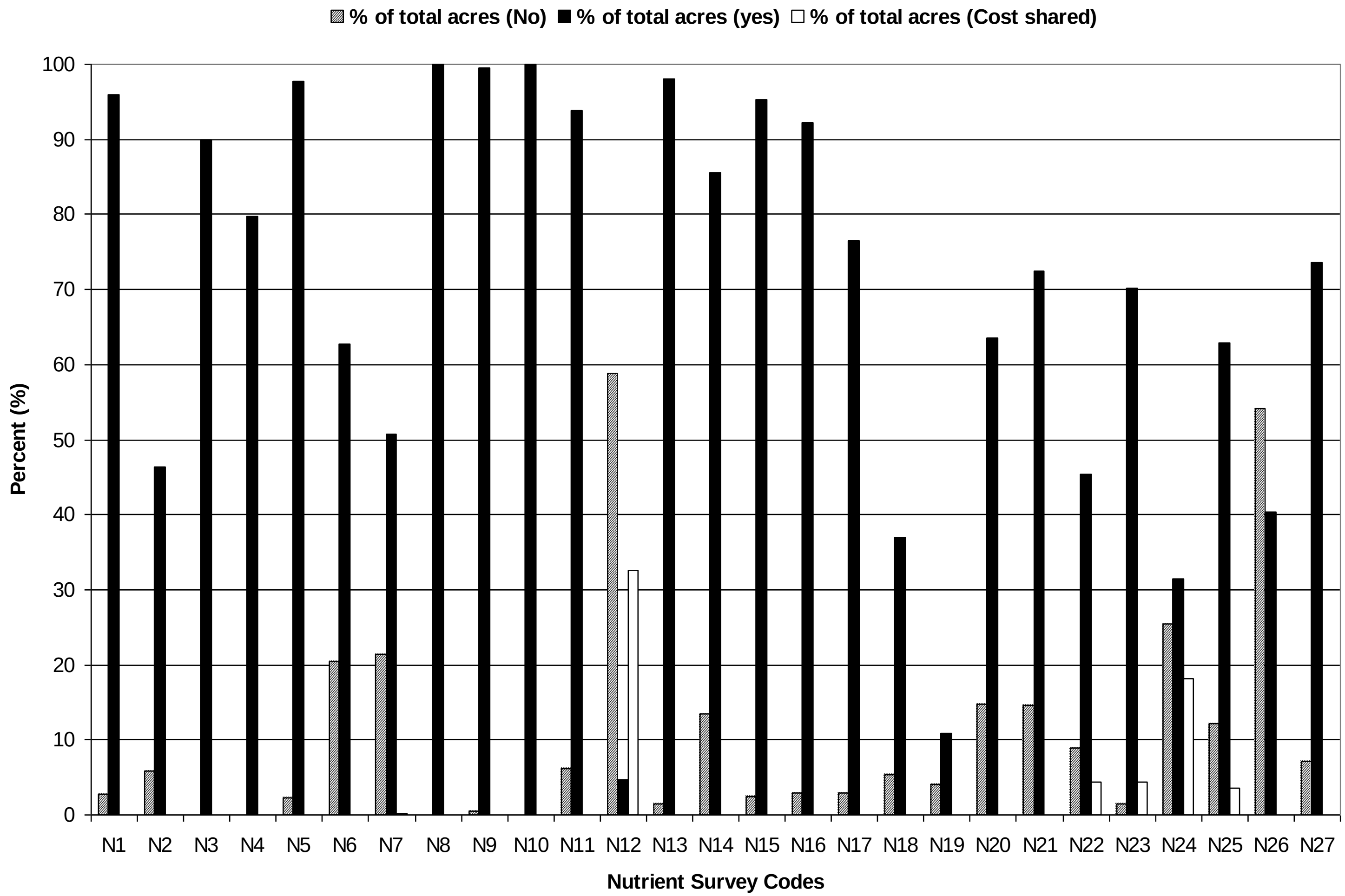

Figure 8 Percentage of total acreage for nutrient management practices with responses- No, Yes, and If Cost Shared.

Similarly, storage of liquid fertilizer tanks on a concrete slab (N7) was done on 58,782 acres. Around 21.4% of the area did not use this practice and growers of 9.1% of the total area disagreed with this practice.

Use of tarp underneath fertilizer spreaders while loading the fertilizer or reuse of spilled fertilizer (N12) was largely unpopular as it was not common on 95% of the area. This practice was used on a very small area of 5484 acres (5% of total). Growers representing one third of the acreage (37,737 acres) said that they would use this practice if it was cost-shared.

On 36,500 acres (31%) of the total area it was found that growers were considering use of controlled release fertilizers in the future for mature trees (N24), whereas on approximately 18% of the area this would be adapted if the practice was cost-shared. Organic amendments seem to be used in the region for citrus production. However, only on 62,695 acres (54% of the total) nutrient from the organic amendment was taken into consideration while designing the fertilizer management program for the grove (N26). Although, avoiding of fertilizer applications from mid-June through mid-September was a largely popular practice (85264 acres), growers representing 9% of the area disagreed with this particular practice.

Aquatic Plants

Aquatic practices such as cleaning and maintenance of ditches to control aquatic weeds (A1), use of mechanical methods to remove aquatic weeds from ditches or canals (A3), and use of herbicides for aquatic-weed control (A4) were popular, as they were utilized on more than 90% of the total acreage (Figures 9 and 10).

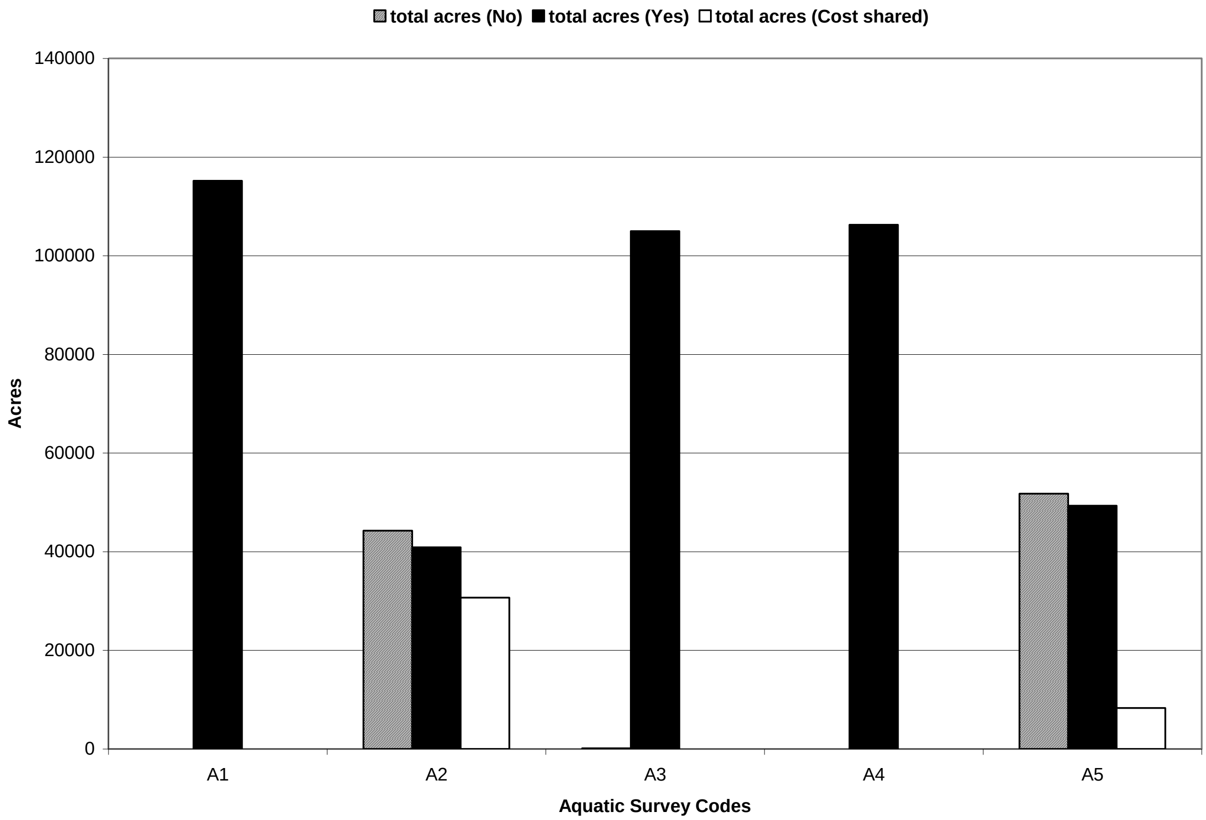

Figure 9. Total acreage for aquatic plant control practices with responses- No, Yes, and If Cost Shared.

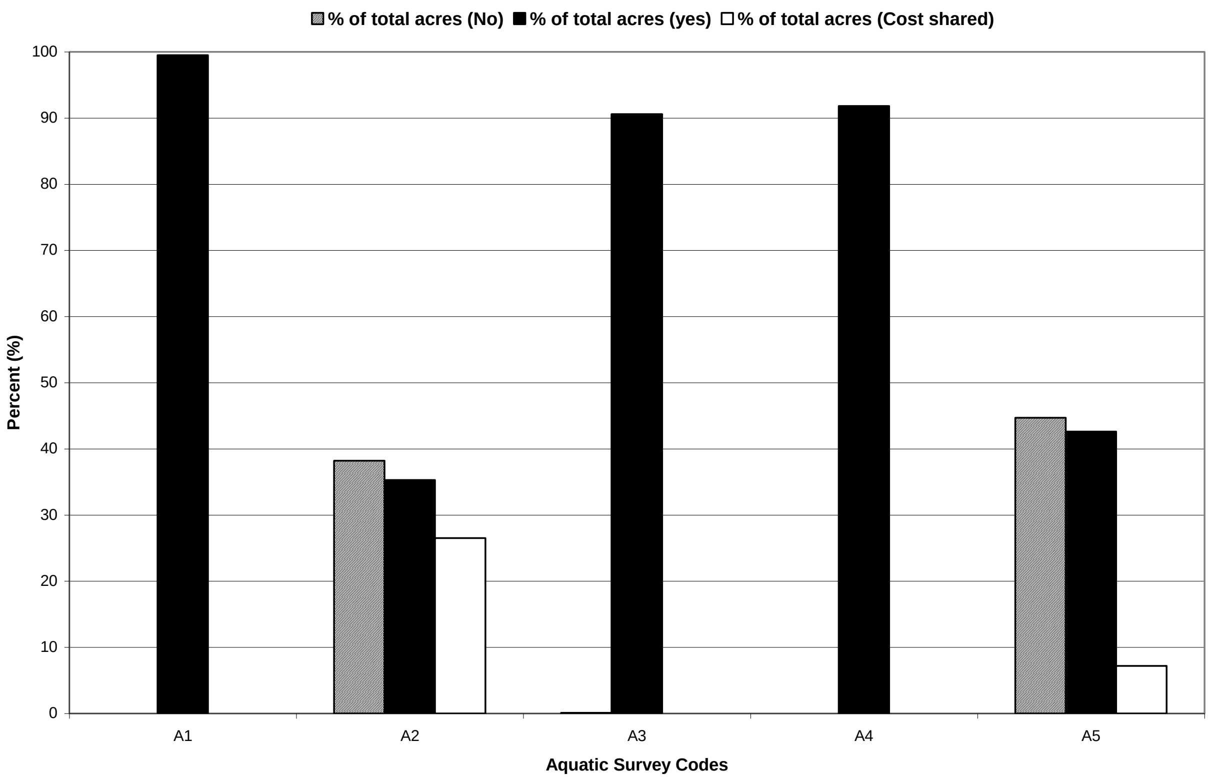

Figure 10. Percentage of total acreage for aquatic control practices with responses- No, Yes, and If Cost Shared.

Use of physical deterrents such as ribbon barriers, traps, or baffle-boxes to limit the movement of aquatic weeds and debris from canals and ditches (A2) and use of biological control agents to manage aquatic weeds (A5) were relatively less popular.

Growers representing 40,865 acres (35% of the total) implemented A2 to limit the movement of aquatic weed from the grove ditches. Implementation of this practice could be improved by 27% by cost-share program, increasing the implementation area from 35% to about 62% of the surveyed area. Biological control agents for weed control were used in 43% of the surveyed area (A5), which could increase by 7% with cost-share.

Summary and Conclusion

A survey of desired water, nutrient, pesticide, sediment, and aquatic plant management practices was conducted in the Gulf Citrus Production Region, which included 60 groves representing 115,791 acres. The surveyed area consisted of 90% of large groves, 9% of medium groves, and approximately 1.4% of small-sized groves.

Initial survey information reflected the size of the grove, the county and watershed it was located in, and the importance of BMP according to the grower/manager. Growers/grove managers of 71,757 (62%) acres reported that BMP implementation to improve net profit on the investment was of utmost importance. However, growers representing more than 74% (86,429 acres) of the area placed the highest degree of importance of BMP implementation on pollution prevention. Microirrigation was found to be the most common mode of irrigation on more than 92% of the surveyed area.

The survey was divided into five categories: water, sediment, pesticide, nutrients, and aquatic plants. Survey results indicating *no use, consistent use,* and *would be used if cost-shard* were considered to be of most importance for the purpose of this study.

For the water survey category it was found that water-management related practices were in use on more than 50% of the total surveyed area. Almost all of the surveyed area used a rain gauge for irrigation management. Use of water-budget and soil moisture devices for irrigation management was popular for 54% and 49% of the total acreage, respectively. Although more than 74% of the total surveyed area had retention/detention areas, growers representing only 6% of the acreage were willing to use it for irrigation if cost shared. Permits to use reservoir water for irrigation were available for only 16% of the total acreage. If cost shared, this practice could be used on 18% of the total acreage. On-site water retention with ditches was implemented for almost 55% of the acreage. On almost 25% of the area, this practice was not used.

More than 50% of the practices related to sediment, pesticide, and nutrient management were adopted on more than 50% of the total area survey. Erosion control measures, such as settling basins or sumps, were not used on 44% of the total acreage. A cost-share program could increase the implementation of this practice on more than 34% of the grove area, which was also the case for construction of riser boards to minimize sediment release (31% of total area). In the pesticide survey there were two practices which were not as widely used as the others- P14 was used only on 36% of the total area and P19 was used on 42% of the total area.

The nutrient survey showed that acreage where ‘no’ response exceeded ‘yes’ responses was observed for two practices- N12 (tarp placement underneath fertilizer spreaders while loading the fertilizer and reuse spilled fertilizer) and N26 (accounting of N and P values from the organic amendments applied and adjusting those values in the future fertilizer rates).

In the aquatic plant control section of the survey, three of five practices were adopted on more than 90% of the surveyed area. The survey indicated wide use of aquatic weed control measures. Use of physical deterrents to limit the movement of aquatic weeds and debris from canals and ditches was not very popular, but growers from more than 26% of the area indicated they would adopt the practice if it was cost-shared. Using biological control agents for weed management was slightly more popular than the previously discussed practice. However, cost-share would improve the implementation of this practice on an additional 7% of the total area.

It seems that cost-sharing could considerably improve implementation of several practices. Collection and reuse of equipment wash-water was dependent on the practice of washing the equipment on a concrete pad. If cost of the collection and reuse structure could be shared, this practice could be used on 29% of the surveyed area which in turn could result in reuse of the collected wash-water.

Settling basins or sumps control erosion sediment/nutrient loss by slowing the surface-water velocity and holding large amounts of sediment through runoff retention. Thus, they are considered important for the purposes of soil and water conservation. Implementation of this practice through cost-share would achieve the largest improvement in terms of acreage (35%).

The second practice that could benefit from cost share on a large area was use of tarp to contain fertilizer spills while loading, which was an unpopular practice. The cost-share requirements from growers representing more than 36,158 acres suggested that perhaps this practice was considered costly. If the cost of implementation of settling basins could be shared, this practice could be adopted on an additional 31% of the surveyed acreage. Similarly, growers from 31% of the total surveyed area were willing to install riser board structures for erosion control if cost-share.

The survey study quantified the extent of BMP usage in GCPR. It will provide baseline information for the BMP implementation as well as help growers and state agencies identify the BMPs which should be cost-shared. The survey quantified the prevalence or insufficient presence of a BMP. Survey results highlighted acreage where cost-share programs are needed to facilitate BMP implementation.

BMPs that were used consistently on the 100% of the total surveyed acreage were:

- Use and maintenance of vegetative cover near canal or ditch banks to stabilize soils
- Calibration of fertilizer spreaders before each application
- Avoiding fertilizer applications under high water table and flooded conditions

BMPs that were not implemented on 50% or more of total surveyed acreage were:

- Placement of tarp underneath fertilizer spreaders while loading the fertilizer and reuse of spilled fertilizer
- Use water from retention/detention reservoirs for irrigation (lack of permit)
- Accounting of the nutrients from organic amendments and adjusting the fertilizer rates accordingly

BMPs that needed cost-share assistance on more than 30% of the total surveyed acreage:

- Reuse of pesticide equipment wash-water
- Placement of tarp underneath fertilizer spreader while loading the fertilizer and reuse of spilled fertilizer
- Construction and use of concrete floor with a 4-inch lip for the pesticide

Survey results could be employed to develop constructive methods to educate grove managers so that they understand the need for a particular BMP, which is currently not in use at their groves. Providing science-based information to the growers with regards to the BMPs' water quality benefits and impact on net income along with the cost share programs may help achieve large-scale implementation. It will be useful to conduct this survey again in the next few years to assess the changes that may occur in the implementation of BMPs.

Appendix 1

Sample Survey Sheet

*** CONFIDENTIAL * CONFIDENTIAL * CONFIDENTIAL *** **CODE __________**

GULF CITRUS PRODUCTION SURVEY
REQUEST RESPONSE BASED ON PRACTICES PRIOR TO CITRUS BMP PROGRAMS

Please take a few minutes to help determine currently practiced activities in the Gulf Citrus Region that may qualify as BMPs. CAREFUL AND ACCURATE RESPONSES ARE CRUCIAL. Thanks for your time in helping complete this survey.

1. What is your business (circle all that apply)? Owner of grove(s) citrus production manager caretaker consultant chemical or equipment sales other (specify)________________________________

How many acres of citrus do you manage and which county (s)? _______________ _______________ ______________
When you decide to use a citrus BMP, please rate how important it is for the BMP to return a net profit on the investment:
Very Important Moderately Important Slightly Important Not at all Important
When you decide to use a citrus BMP, how important it is for you to be certain that the BMP will prevent pollution:
Very Important Moderately Important Slightly Important Not at all Important
What type of irrigation System do you use?
Micro-sprayer Drip Seepage (furrow) Overhead
What is your current use of the following practices; NOTE that not all are BMPs (check all answers that apply to your use)?

Question codes		No	Sometimes	Use Consistently (yes)	Plan To use	Would If Cost Shared	Disagree With the practice
	WATER:						
W1	Do you use a rain gauge for irrigation management?						
W2	Do you use a water budget (ET) data to schedule irrigation?						
W3	Do you use water table monitoring wells / soil water measurement devices to schedule irrigation / drainage events?						
W4	Do you have retention / detention areas (reservoirs) on site?						

		No	Sometimes	Use Consistently (yes)	Plan To use	Would If Cost Shared	Disagree With the practice
W5	Does your permit allow use of reservoir water for irrigation?						
W6	Do you use water from reservoirs for irrigation?						
W7	Do you use canals and ditches to hold runoff / drainage water in the grove?						
W8	Do you regularly use line cleaning chemicals (e.g. chlorine) to prevent emitter clogging for microirrigation?						
	SEDIMENT:						
S1	Do you use erosion control measures (settling basins or sumps)						
S2	Do you restrict the herbicide band to the tree canopy dripline?						
S3	Are settling basins inspected and maintained at an appropriate frequency to meet their intended function?						
S4	Are removed sediments placed so that they do not re-enter cleaned ditches / canals?						
S5	Do you have riser boards rather than screw gates to minimize sediment release?						
S6	Is vegetative cover maintained near canal or ditch banks to stabilize soils?						
S7	Are bank shoulders sloped to minimize overland flow of stormwater directly down banks?						
S8	Do you use riprap, concrete headwalls, sandbags, or wingwalls to protect ditch and canal banks from erosion?						
S9	Are vegetative water furrows, drain tiles, and settling basins used to ensure minimum movement of sediment?						
S10	Do you use any measures to disperse and / or reduce the velocity of water entering reservoir (flap, concrete pad)?						
S11	Are culvert structures routinely inspected and properly maintained to meet their intended function?						
S12	Are measures taken to prevent erosion (sediment loss) during earth-moving construction / maintenance activities (i.e., hay bales, silt fence)?						
		No	**Sometimes**	**Use Consistently**	**Plan To**	**Would If**	**Disagree With**

				(yes)	use	Cost Shared	the practice
	PESTICIDE:						
P1	Are routine inspections of the pesticide storage area conducted to check for leaks and spills?						
P2	Are containers stored in a contained area to prevent runoff into streams, ditches, or wellheads?						
P3	Are excess spray solutions containing pesticides managed properly by applying to a target site at labeled rates?						
P4	Are sprayer nozzles turned off at the trunk of the last tree in the row and a pass made around the outside perimeter of the block (wrapping), or nozzles off at foliage of last tree?						
P5	Do you follow label recommendations concerning wind speed when spraying chemical?						
P7	Are appropriate measures taken to reduce spray drift using; Nozzle adjustment between beds & furrows						
P8	Are appropriate measures taken to reduce spray drift using; Spray pressure?						
P9	Are appropriate measures taken to reduce spray drift using; Drift control materials?						
P10	Is the outside row sprayed inward using nozzles on one side only, with spray directed away from aquatic areas?						
P11	Are all agri-chemicals stored in a locked facility?						
P12	Does this facility have a concrete floor with a 4" lip?						
P13	Is application equipment washed on a concrete pad with a sump?						
P14	Is pesticide equipment wash-water collected and reused?						
P15	Are anti-siphoning devices or other measures utilized to prevent back siphoning of chemicals (fertilizer, pesticides etc.) into ditches, canals, or wells?						
		No	**Sometimes**	**Use Consistently**	**Plan To**	**Would If**	**Disagree With**

				(yes)	use	Cost Shared	the practice
P16	If pesticides are mixed at or near the same site year after year, is there a concrete pad with a sump to minimize contamination from small spills and leaks?						
P17	Are mix / load stations located where runoff will not carry spilled chemicals into surface water bodies?						
P18	Do you use a system of portable mix / load stations or water only nurse tanks?						
P19	Is the same mix locations used more than once in the same year?						
	NUTRIENT:						
N1	Are you aware of the UF-IFAS fertilizer recommendations (SP-169)?						
N2	Do you follow UF-IFAS fertilizer recommendations (SP-169)?						
N3	Do you use soil analyses to determine how much fertilizer and amendments to apply?						
N4	Do you use tissue analyses to determine how much fertilizer and amendments to apply?						
N5	Are the fertilizer applicator(s) properly trained in the handling and loading of spreaders?						
N6	Has the training been documented?						
N7	Are liquid fertilizer tanks stored on a concrete slab?						
N8	Do you calibrate fertilizer spreaders before each application?						
N9	Do you apply fertilizer within the root zone of trees, within drip line, on the high side of the bed and avoid application in furrow?						
N10	Do you avoid fertilizer application to soils under high water table and flooded conditions?						
N11	Do you consider weather forecasts before applying fertilizer, to avoid run-off and leaching?						
N12	Do you place a tarp underneath fertilizer spreaders while loading the fertilizer and reuse spilled fertilizer?						
N13	Do you take precaution (e.g. berm between road and ditch /						

	staging area) when loading fertilizer near ditches, canals, and wells?						
N14	Do you have vegetative filter strips to prevent movement of fertilizers to environmentally sensitive areas (e.g. canals, ditches)?						
N15	Are abandoned wells in your grove plugged?						
N16	Do you alternate fertilizer loading sites throughout the grove?						
N17	Do you split dry-soluble fertilizer applications? a) 3						
N18	Do you split dry-soluble fertilizer applications? a) 4						
N19	Do you split dry-soluble fertilizer applications? c) 5 or more						
N20	Do you use fertigation?						
N21	Do you combine your fertigation with other fertilizer applications (e.g. dry, liquid, suspension, controlled release)?						
N22	Do you use controlled release fertilizer?						
N23	Do you plan to use controlled release fertilizers in the future a) For resets ?						
N24	Do you plan to use controlled release fertilizers in the future b) For mature trees?						
N25	Do you use organic amendments (yard waste, municipal waste, animal manures, or combination)?						
N26	Do you account for the nutrient (N and P) from organic amendments and adjust your fertilizer rates accordingly?						
N27	Do you avoid fertilizer applications between mid-June through mid-September?						
	AQUATIC PLANT:						
A1	Are ditches cleaned and maintained to control aquatic plants?						
A2	Are physical deterrents such as ribbon barriers, traps, or baffle boxes used to limit the movement of aquatic weeds and debris from canals and ditches?						
		No	**Sometimes**	**Use**	**Plan**	**Would**	**Disagree**

				Consistently (yes)	To use	If Cost Shared	With the practice
A3	Are mechanical methods used to remove aquatic weeds from ditches or canals?						
A4	Are herbicides used to control aquatic weeds within ditches/canals?						
A5	Are biological control agents (flea beetles, hyacinth weevils, or grass carp) used to manage aquatic weeds?						

Appendix 2

Table 2. Summary of Survey Results

	No		Yes		Would if Cost Shared	
Water	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**
W1	620	0.54	114641	99	0	0
W2	29409	25.4	62179	53.7	240	0.21
W3	30817	26.61	57400	49.57	404	0.35
W4	10478	9.05	86608	74.8	7033	6.07
W5	67065	57.92	18724	16.17	0	0
W6	53211	45.95	13493	11.65	21158	18.27
W7	28133	24.3	63316	54.68	0	0
W8	34073	29.43	38736	33.45	164	0.14
Sediment						
S1	51154	44.12	24149	20.86	39958	34.51
S2	7864	6.79	104552	90.23	0	0
S3	16042	13.85	28213	24.37	0	0
S4	770	0.66	105021	90.7	0	0
S5	6570	5.67	63063	54.46	36158	31.23
S6	0	0	115791	100	0	0
S7	0	0	111439	96.24	0	0
S8	4160	3.59	83202	71.86	4000	3.45
S9	620	0.54	112971	97.56	0	0

S10	5497	4.75	94306	81.45	3395	2.93
S11	150	0.13	113356	97.9	0	0
S12	15722	13.58	54739	47.27	10220	8.83
Pesticide						
P1	1495	1.29	106496	91.97	0	0
P2	5847	5.05	102144	88.21	0	0
P3	0	0	113591	98.1	0	0
P4	0	0	111891	96.63	0	0
P5	0	0	108616	93.8	0	0
P6	0	0	109791	94.82	0	0
P7	2220	1.92	111371	96.18	0	0
P8	3375	2.91	103056	89	0	0
P9	7215	6.23	79535	68.69	0	0
P10	1192	1.03	114599	98.97	0	0
P11	3611	3.12	105011	90.69	5039	4.35
P12	39570	34.17	57182	49.38	18164	15.69
P13	17999	15.54	35296	30.48	33663	29.07
P14	41412	35.76	26996	23.31	41683	36
P15	4591	3.96	107036	92.44	164	0.14
P16	23665	20.44	24605	21.25	5435	4.69
P17	4000	3.45	106979	92.39	0	0
P18	10803	9.33	93527	80.77	0	0
P19	49044	42.36	39874	34.44	0	0
Nutrients						
N1	3300	2.8	111011	95.9	0	0
N2	6667	5.8	53744	46.4	0	0
N3	0	0	104056	89.9	0	0
N4	0	0	92329	79.7	0	0

N5	2575	2.2	113216	97.8	0	0
N6	23682	20.5	72761	62.8	0	0
N7	24831	21.4	58782	50.8	164	0.1
N8	0	0	115791	100	0	0
N9	620	0.5	115171	99.5	0	0
N10	0	0	115791	100	0	0
N11	7122	6.2	108669	93.8	0	0
N12	68090	58.8	5484	4.7	37737	32.6
N13	1750	1.5	113421	98	0	0
N14	15627	13.5	98972	85.5	0	0
N15	2820	2.4	110342	95.3	0	0
N16	3395	2.9	106866	92.3	0	0
N17	3376	2.9	88565	76.5	0	0
N18	6100	5.3	42897	37	0	0
N19	4792	4.1	126095	10.9	0	0
N20	17167	14.8	73566	63.5	0	0
N21	16876	14.6	83793	72.4	0	0
N22	10337	8.9	52492	45.3	5000	4.3
N23	1600	1.4	81219	70.1	5000	4.3
N24	29578	25.5	36500	31.5	21010	18.1
N25	14144	12.2	72837	62.9	4000	3.5
N26	62695	54.1	46774	40.4	0	0
N27	8319	7.2	85264	73.6	0	0
Aquatic						
A1	0	0	115176	99.5	0	0
A2	44271	38.2	40865	35.3	30655	26.5
A3	150	0.1	104964	90.6	0	0
A4	0	0	106269	91.8	0	0

A5	51753	44.7	49304	42.6	8302	7.2